CALIFORNIA DIVISION OF MINES AND GEOLOGY

FAULT EVALUATION REPORT FER-133

July 30, 1982

1. Name of fault

Midland fault zone.

2. Location of fault

Sacramento, Solano, and Yolo Counties (figure 1).

3. Reason for evaluation

Part of 10-year fault evaluation program (Hart, 1980).

4. List of References

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Toppozada, T.R., Real, C.R., and Parke, D.L., 1981, Preparation of isoseismal maps and summaries of reported effects for pre-1900 California earthquakes: California Division of Mines and Geology Open-file Report 81-11SAC, p. 107-109, 164. (Annual technical report to U.S. Geological Survey).

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U.S. Geological Survey, 1974, Aerial photos 10-62 to 69; 11-14 to 21, vertical, low sun angle, color, scale approximately 1:36,000.

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5. Review of available data

The Midland fault zone, first described by Frame (1944), is thought to be a north-northwest trending, steeply west-dipping normal fault. The fault zone depicted by Jennings (1975) connects with the Sweitzer fault, an east-dipping reverse fault exposed in the Rumsey Hills (Kirby, 1943) (figure 1). However, Wagner, et al, (1981) did not find evidence supporting the connection of the Midland fault with the Sweitzer fault. Indeed, evidence supporting the existence of the Midland fault north of Winters was not found (Wagner, p.c., 1982).

The magnitude of offset along the Midland fault has been variously reported as 500 feet of vertical offset, west side down (Frame, 1944); 1,000 feet of vertical offset, down to the west, was reported by Reynolds and Reynolds (1963). Redwine (1972) postulates that up to 6 miles of right-lateral strike-slip displacement, based, he admits, on speculative evidence, may explain the varying magnitude and sense of offset along the Midland fault.

Reynolds and Reynolds (1963) did not observe evidence of displacement on the Midland fault younger than early Oligocene time and Wagner, et al (1981) do not show beds younger than early Tertiary as offset by the Midland fault (figure 2). However, most of the data on the Midland fault has originated from oil and gas exploration. Thus, it should be recognized that data on non petroleum-bearing formations may not have been as carefully developed and interpreted, possibly overlooking the offset of upper Tertiary formations. The Midland fault has not been mapped as an observable surface feature by any worker, including Sims, et al (1973), Helley and Herd (1977), and Helley and Barker (1979).

An earthquake of M 6.4 occurred April 19, 1892 halfway between Vacaville and Winters (Toppozada, et al, 1981; figure 3). This earthquake was followed by aftershocks of estimated M 6.2 and M 5.5 on April 21 and April 30, respectively (Toppozada, et al, 1981). No causative fault was determined for these events, but speculation has centered around the Midland fault due to its proximity to the assigned epicenter and area of maximum reported intensity (figure 3).

Surface fault rupture may have occurred during this earthquake sequence near the town of Allendale. The April 23, 1892 edition of the San Francisco Examiner reports that"... by the old Allendale road, five miles west of Dixon, a fissure in the ground can be traced for fully half a mile. It opened at first over an inch wide and closed again as the edges of the crack crumbled inwards. Now all that is left is a ridge of fine dust, like the trail of some huge insect." The Dixon Tribune (April 29, 1892) reported that open fissures occurred near Allendale. The fissures ranged in width from one to three inches and extended about a mile.

The trend and continuity of these cracks was not recorded. Ground cracking due to shaking was widespread throughout the area and the April 23, 1892 edition of the Morning Call indicates that many of the fissures observed had a general north-south trend (Dale, 1977). It seems that the cracks near Allendale are extensional rather than a mole track formed by compressional deformation, but no conclusion can be reached regarding their cause. Because the trend of the cracks is not known, an equally plausible explanation could be slumping or settlement, perhaps along or near (Sweeney) ~~Sweany~~ Creek.

Several workers have attempted to locate this fissure, or to find evidence of faulting in the general area described (figure 4) although results have been inconclusive. A geophysical survey east of Allendale indicated a weak gravity anomaly that corresponds to a change in slope (down to the east) revealed by a leveling survey (Bennett, et al, 1980). It is not known whether the change in slope is natural or artifically produced by man, since the Survey was located along a road and near a canal excavation. The area of the gravity low was further investigated using seismic refraction and magnetometer, but no anomalous conditions were observed (Bennett, et al, 1980).

Several circumstantial pieces of evidence suggest that a northwest-trending fault may be located between Sweany Creek and locality 1 (figure 4). At least seven drainages are deflected right-laterally along a northwest trend and tonal lineaments, though discontinuous, suggest an association with the deflected drainages. The right-lateral deflection of Sweany Creek is within a half-mile of the mile-long fissure reported after the 1892 earthquake. Small, inferred closed depressions were observed by this writer along the inferred fault trace, based on air photo interpretation, but there is no clear evidence that the depressions are related to active faulting. A subtle, southwest-facing scarp was observed by this writer at locality 2 (figure 4), but the scarp does not extend for more than about 700' to 800' and is somewhat sinuous. These geomorphic features are within the area and are approximately on trend with the previously mentioned gravity low (figure 4).

The tonal lineaments associated with the deflected drainages generally are not well-defined and are discontinuous. There are many additional tonal lineaments away from the general trend of the inferred fault, many with a similar northwest trend. Some of the tonal lineaments can be identified as buried stream channels, and it is suspected that some of the tonals along the trend of the inferred fault may be related to fluvial processes rather than faulting.

There is no systematic magnitude of deflection of drainages along the trend of the inferred fault. Sweany Creek is deflected about 2,000 feet in a right-lateral sense and additional drainages along the trend of the inferred fault vary greatly in the magnitude of offset. If the large deflection of Sweany Creek is due to recurring tectonic offset, then there should be additional geomorphic evidence of surface fault rupture, such as closed depressions, linear troughs, or scarps. Geomorphic features that were observed along the trend of the inferred fault by this writer, based on air photo interpretation and a brief field check, are not conclusive evidence of recently active faulting. All of the drainages flowing along an easterly course out of the English Hills meander when the valley floor is encountered, generally to the south. Thus, random meanders may appear to be right-laterally deflected drainages.

Perhaps the most compelling evidence against the presence of a fault along the northwest trend is at locality 3 (figure 4). An incised, right-laterally deflected drainage with associated tonal lineaments was inspected by this writer for evidence of soil or bedrock offset. A nearly continuous exposure of Pliocene Tehama Formation overlain by older alluvium (Sims, et al, 1973) was observed in the stream cut. The Tehama Formation, consisting of poorly-bedded sandy siltstone overlain by an approximately 2-1/2' to 3' thick gravel bed, was nearly horizontal along the entire exposure in the gully. The area of the inferred fault was partly concealed by a slump block, but bedding upstream and down stream was continuous, thus ruling out the possibility of vertical displacement. A small component of strike-slip faulting cannot conclusively be ruled out because exposure of the Tehama Formation was not continuous (a 35' to 40' long slump concealed a portion of the gully wall). However, the presence of a fault is unlikely because of the undisturbed nature of the Pliocene-age sedimentary rocks.

6. Conclusions

There is no stratigraphic evidence indicating that the Midland fault extends to the surface or offsets rocks younger than early Oligocene in age (Reynolds and Reynolds, 1963; Wagner, et al, 1981). However, offset of upper Tertiary rocks cannot be ruled out because data on these non petroleum-bearing formations may not have been as carefully developed and interpreted as the information on older, petroleum-bearing formations. Although many geologists interpret the Midland fault to be a steeply west-dipping normal fault (Frame, 1944; Silcox, 1962; Reynolds and Reynolds, 1963), Redwine (1972) postulates a major, variably but steeply dipping, predominantly right-lateral strike-slip fault. Redwine (1972) states that this assumption is based on somewhat speculative evidence. Wagner (p.c., 1982) concluded that there is no evidence supporting the continuation of the Midland fault north of Winters.

A M 6.4 earthquake occurred on April 19, 1892 near Vacaville (Toppozada, et al, 1981) (figure 3). The epicenter is thought to be near Allendale, where a fissure from 1/2 mile to 1 mile long was reported (San Francisco Examiner, April 23, 1892, Dixon Tribune, April 30, 1892) (figure 4). It has been suggested by various workers that this fissure may have been surface fault rupture, but this is highly speculative. Geomorphic features such as right-laterally deflected drainages and tonal lineaments suggest recent faulting within about 1/2 mile of the fissure observed after the 1892 earthquakes (figure 4). However, there are many linear tonal contrasts in the alluvium that trend northwest and streams flowing east out of the English Hills eventually flow south, often resembling right-laterally deflected draingages. A stream cut along the trend of the inferred fault exposed continuous, nearly flat-lying beds of the Pliocene Tehama Formation (figure 4). No evidence of offset was observed by this writer and it is concluded that the geomorphic features along the inferred fault were formed by geologic processes other than active faulting.

7. Recommendations

Recommendations for zoning faults for special studies are based on the criteria of sufficiently active and well-defined (Hart, 1980).

Do not zone for special studies traces of the Midland fault. There is no evidence to suggest that this fault has been active since early Tertiary time. The fault zone does not extend to or near the surface and thus cannot be considered to be well-defined.

8. Report prepared by William A. Bryant, 7-30-82.

William A. Bryant

I concur with recommendations.
E W Hart
9/16/82

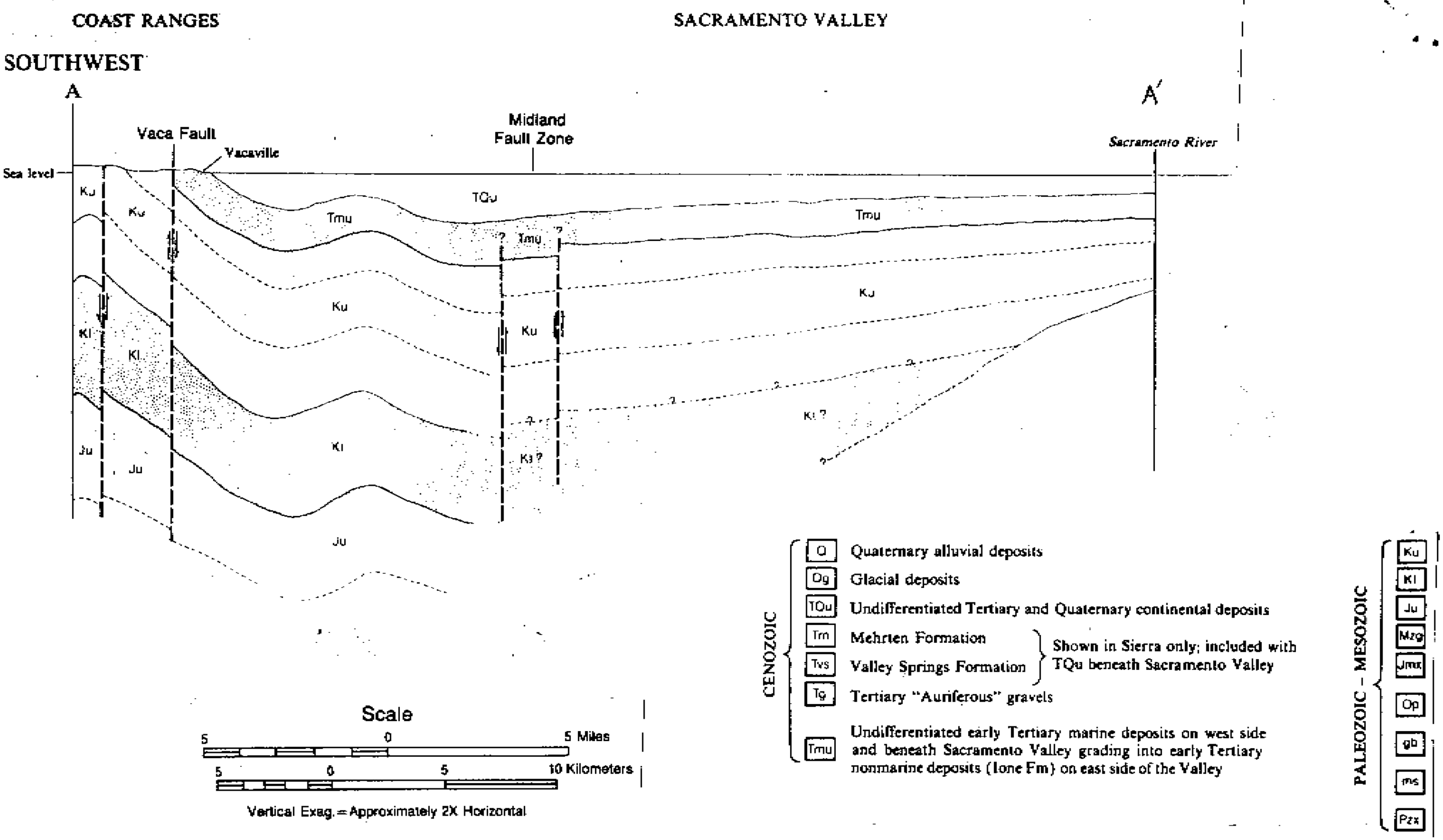

Figure 2 (to FER-133). Generalized southwest-northeast cross section showing the Midland fault. Refer to figure 1 for approximate location of cross section. (From Wagner, et al, 1981).

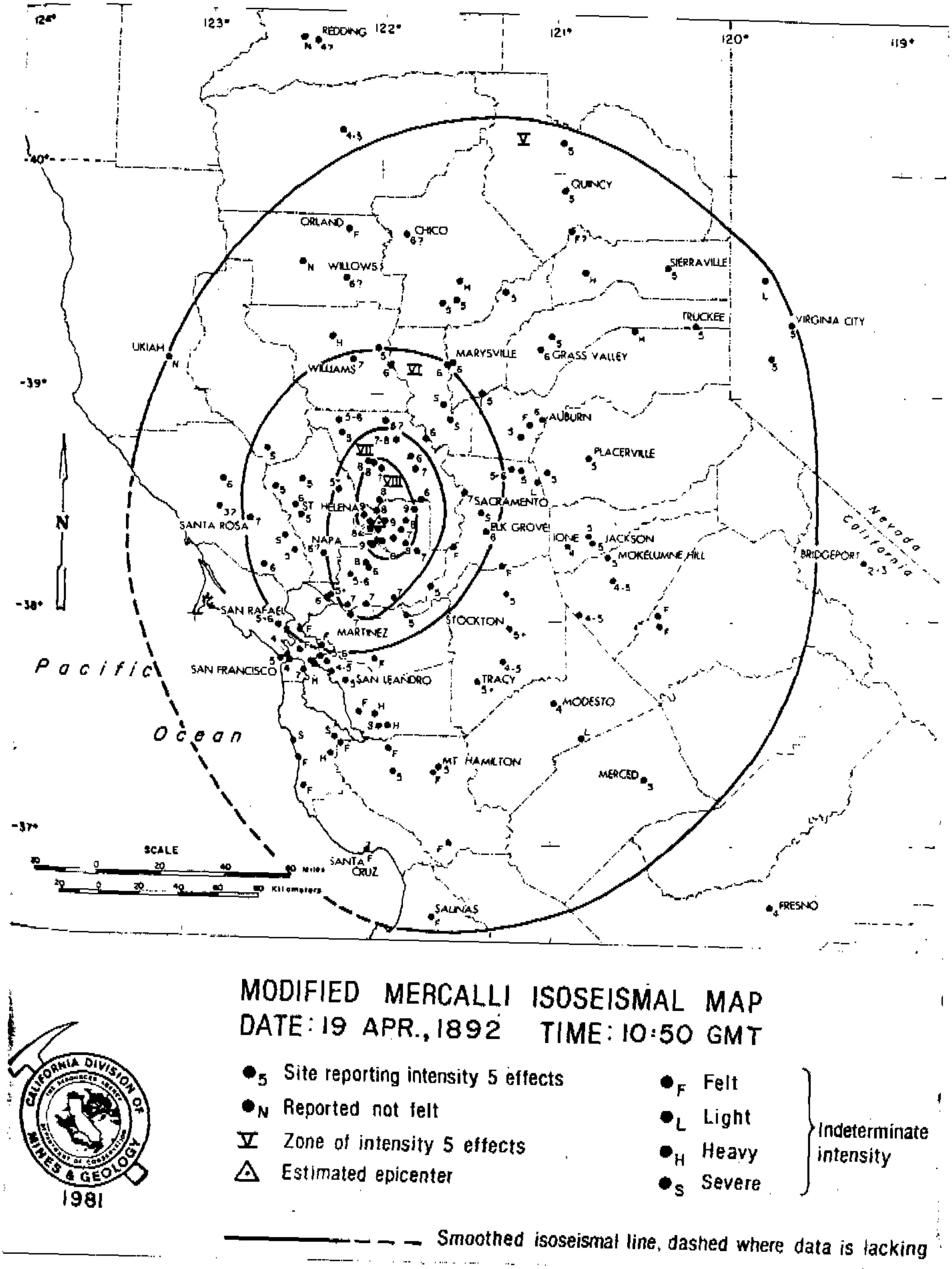

Figure 3 (to FER-133). Isoseismal map of the April 19, 1892 Vacaville earthquake. From Toppozada, et al (1981).